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(54) Multi-electrode intravascular lead

(57) An intravascular lead having a distal and proximal ends, comprising at least one electrode electrically connected to a conductive insulated wire of a predetermined diameter, tapered at least at one predetermined location along said wire towards its distal end to provide a predetermined smaller diameter wire, thus presenting a main proximal relatively thick lead segment, and a relatively thinner distal lead segment, allowing catheterization of the cardiac sinus and in particular the delivery of said electrode into a selected coronary venule.

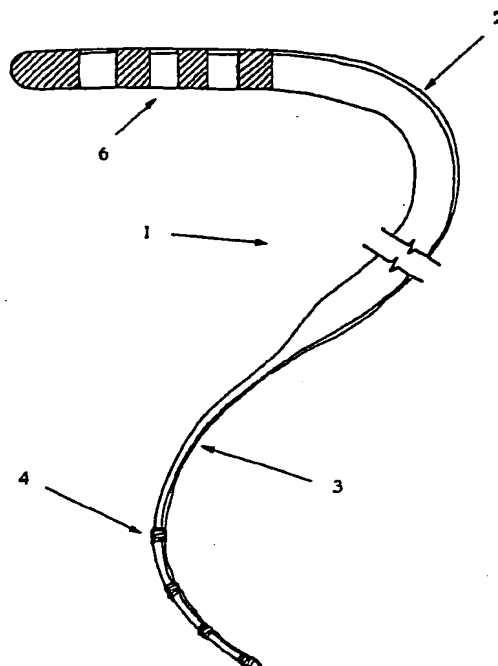


Fig. 1

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ment, and a relatively thinner distal lead segment, allowing catheterization of the cardiac sinus and in particular the delivery of said electrode into a selected coronary venule.

[0015] The tapering of the end of the wire renders the lead lower total impedance relatively to other prior art leads.

BRIEF DESCRIPTION OF THE FIGURES

[0016] In order to better understand and appreciate the present invention a detailed description of the invention is provided below, with reference to the attached Figures, in which:

- Fig. 1 illustrates a general view of a typical embodiment of the multi-electrode low-impedance intravascular lead of the present invention (a tetrapolar lead).
- Fig. 2 demonstrates the use of the same typical embodiment of the present invention in cardiac coronary veins.
- Fig. 3 depicts a see-through view of the distal end of same typical embodiment of the low-impedance intravascular lead of the present invention.
- Fig. 4 is a detailed view of longitudinal cross-section across the narrowing section of the low-impedance intravascular lead of the present invention, near its distal end.
- Fig. 5 is a longitudinal cross-section view of another embodiment of the multi-electrode intravascular lead of the present invention, having a varying diameter distal end.

DETAILED DESCRIPTION OF THE INVENTION AND FIGURES

[0017] Fig. 1 illustrates a general view of a typical embodiment of the multi-electrode low-impedance intravascular lead of the present invention. The lead (assigned the general reference numeral 1) comprises a low-impedance thick lead segment (2) provided with a four-connections connector (6) at its proximal end, and a high-impedance thin lead segment (3) towards the distal end of the lead, with a four electrode array (4). The thin segment length is predetermined by the length required in the catheterization of the cardiac sinus and cardiac venules. As shown, the lead segment (2) is thick (and thus can be made to have low resistance) along most of its length, but has a thinner segment (3) towards its distal end, allowing for more ease and convenience with the catheterization of the coronary sinus and cardiac veins.

[0018] Fig. 2 illustrates the use of the same typical embodiment of the present invention in cardiac coronary veins. As shown, the thick segment (2) typically having a diameter of 6 to 8 French, of the lead extends

from the implantable device all the way down the vein to the right atrium (5). This thick lead segment (2) may have a length of 30 to 40 cm to enable appropriate positioning of the implantable device, as well as sufficient "slack" to accommodate displacement, rotation and growth without subsequent dislocation of the electrodes from their predetermined position. On the other hand, the thin, distal segment (3) may have a length of only 5 to 10 cm to enable catheterization of the coronary veins.

[0019] The unique configuration of the multi-electrode intravascular lead of the present invention makes it easier to be navigated through the coronary sinus and permanently located in the coronary venule of choice. At the same time, this makes it possible to have a lead with connector-to-electrode resistance of only a few tens of Ohms. For example, the thick segment can be manufactured to pose a resistance of 5 to 20 Ohms (say 15 Ohms), while the shod, thin segment may add an additional resistance of 10 to 40 Ohms adding up to a total connector-to-electrode impedance of 15 to 60 Ohms (a 5 to 10-fold improvement over the prior art devices).

[0020] Fig. 3 shows the construction detail of a preferred embodiment of the multi-electrode low-impedance intravascular lead of the present invention.

[0021] Shown is a tetrapolar intravascular lead (generally referenced by the numeral 10), constructed in accordance with the present invention, comprising four coated insulated electrically conductive wires (12-15), coiled parallelly (along a substantial portion of the lead), externally covered by an insulating jacket (16). At a transition area (17), the wires (12-15), still coiled parallelly, become narrower, thus the whole lead diameter decreases, to present a thinner distal end segment (18). At the point at which it is desirable to reduce the lead diameter, the cross-section of the wires forming the parallel coils is gradually reduced. Typically, the reduction in the wire cross-section area would be in the range of 30 to 70 per cent from the original thick segment cross-section area. This is achieved by the use of tapered wires (19), one of which is depicted in Fig. 3A, shown magnified. As this happens, the outer diameter of the coils is also reduced, but at the same time, a lumen of substantially constant diameter is retained, making it possible to use the standard or tapered stylets to aid the implant and positioning of the lead. At the distal end there is an array of electrodes (11).

[0022] Although the use of a gradually-tapered wire is the preferred method of construction, other techniques can be equally applied in order to provide a narrowing wire. As shown in Fig. 4, if filament cables (21-24) are used as the lead constructors, then the tapering can be done discretely, by reducing the number of filaments in the wire within the transition area of the wire. At the thick segment of the lead (25), the cable is constructed of 7 filament wires. At a predetermined transitional location (26) the cables became thinner due to reduction in the number of filament wires used - in this

claims 1-10, wherein said thin distal lead segment length measures between 5 to 10 cm.

12. The intravascular lead according to any one of claims 1-11, wherein said proximal relatively thick lead segment poses a resistance of between 5 to 20 Ohms. 5
13. The intravascular lead according to any one of claims 1-12, wherein said distal relatively thinner lead segment poses a resistance of between 10 to 40 Ohms. 10
14. The intravascular lead according to any one of claims 1-13, wherein the total impedance of said lead is between 15 to 60 Ohms. 15
15. The intravascular lead according to any one of claims 1-14, wherein said insulated electrically conductive wire is coiled along a substantial portion of the lead. 20
16. The intravascular lead according to any one of claims 1-15, wherein said insulated electrically conductive wire is externally covered by an insulating jacket. 25
17. The intravascular lead according to any one of claims 1-16, wherein a lumen of substantially constant diameter is retained inside the lead. 30
18. The intravascular lead according to any one of claims 1-17, wherein said tapering is achieved by a gradual reduction of the diameter of the wire used in the construction of said lead at a predetermined transition location on said wire. 35
19. The intravascular lead according to any one of claims 1-18, wherein said lead tapering is achieved by the use of a filament cable in the construction of said lead, and wherein at a predetermined location along said filament cable, the number of filament wires forming said cable is reduced. 40
20. The intravascular lead according to any one of claims 1-19, wherein said lead is tapered in several locations along said lead. 45

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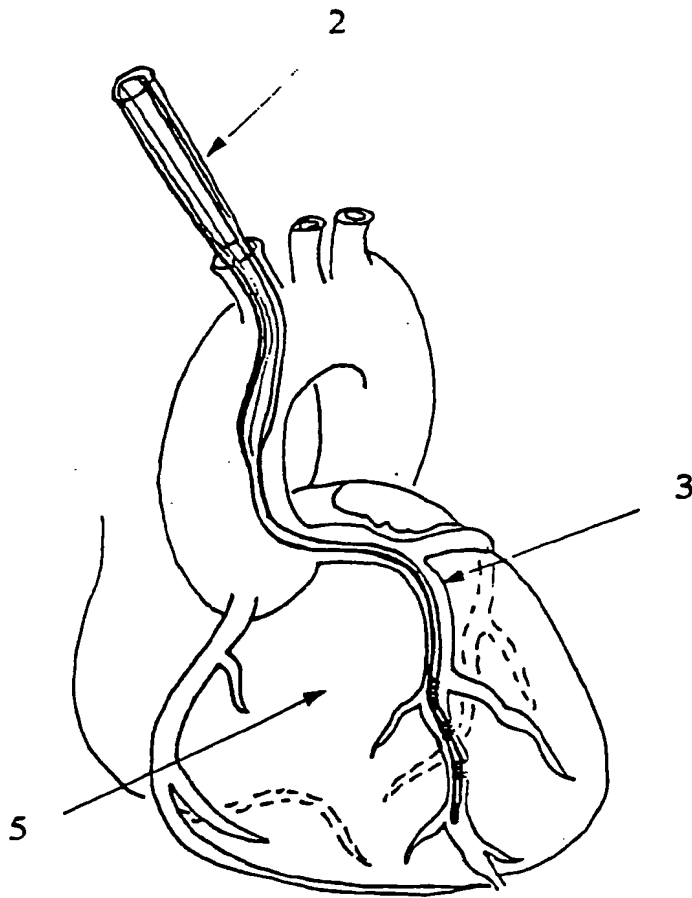


Fig. 2

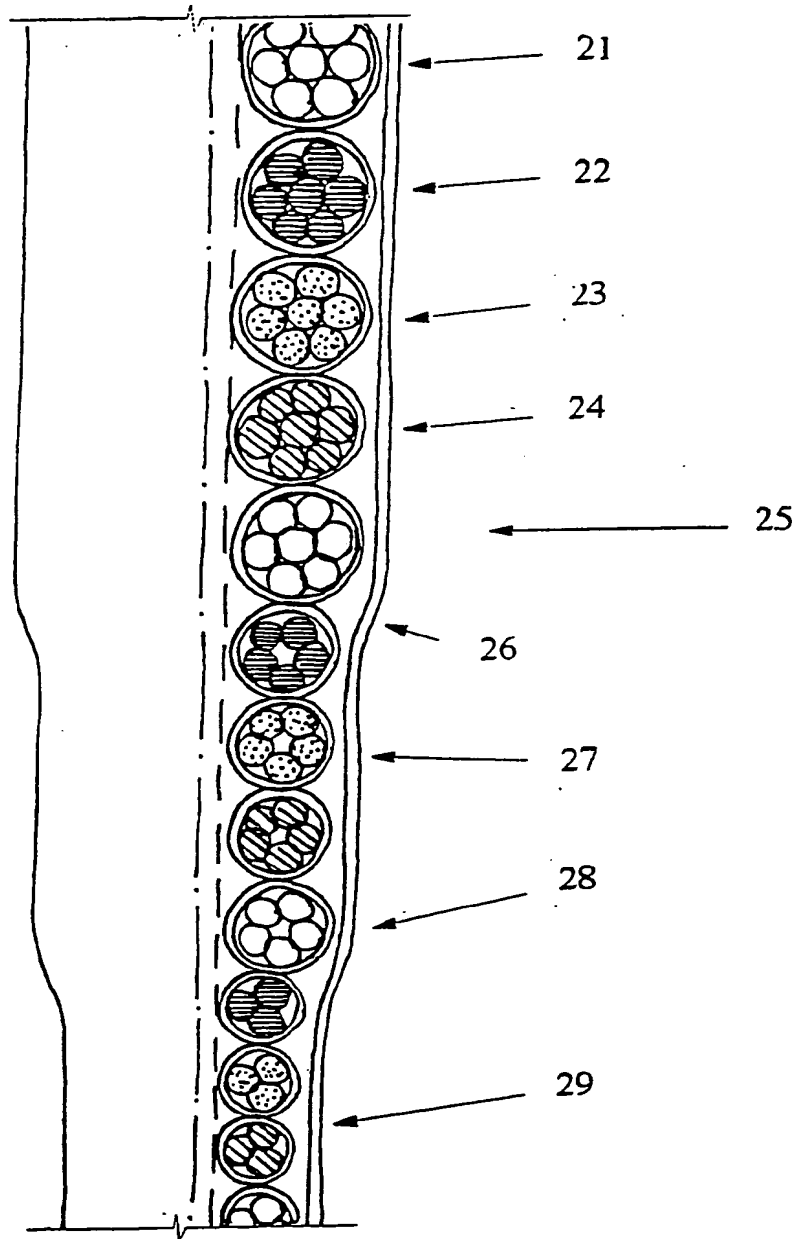


Fig. 4



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EUROPEAN SEARCH REPORT

Application Number
EP 99 20 4367

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A,D	US 5 755 766 A (CHASTAIN STUART R ET AL) 26 May 1998 (1998-05-26) * column 4, line 31-37 *	1	A61N1/05
A	WO 98 43697 A (CARDIAC PACEMAKERS) 8 October 1998 (1998-10-08) * page 12, line 1-19; figure 11 *	1	
A,P	EP 0 919 254 A (MEDTRONIC INC) 2 June 1999 (1999-06-02) * column 3, line 28-43 * * column 6, line 12-29 *	1	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.7) A61N
Place of search THE HAGUE		Date of completion of the search 28 March 2000	Examiner Grossmann, C.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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